CLAIMS

Therefore, having thus described the invention, at least the following is claimed:

1. A method for back-side-of-die, through-wafer guided-wave clock distribution, comprising:

providing an optical clock signal and an integrated circuit device, wherein the integrated circuit device includes a device substrate and the optical clock signal has a wavelength so that the optical clock signal can pass through the device substrate;

distributing the optical clock signal at a global level of the integrated circuit device through a uniform, unfocused guided-wave progression; and

propagating the optical clock signal vertically, through the device substrate directly to a local level of the integrated circuit device.

2. A method for unfocused guided-wave clock distribution, comprising:

providing an optical clock signal and an integrated circuit device, wherein the integrated circuit device includes a device substrate and the optical clock signal has a wavelength so that the optical clock signal can pass through the device substrate;

propagating the optical clock signal vertically, through the device substrate, from the front-side of the integrated circuit device to the back-side of the integrated circuit device;

distributing the optical clock signal from a vertical to horizontal orientation on the back-side of the integrated circuit device;

distributing the optical clock signal in a plurality of horizontal directions on the back-side of the integrated circuit device through a uniform, unfocused guided-wave progression;

distributing the optical clock signal from a horizontal to vertical orientation on the back-side of the integrated circuit device; and

propagating the optical clock signal vertically, back through the integrated circuit device substrate, from the back-side of the integrated circuit device to the chip-level of the integrated circuit device.

3. The method of claim 2, further comprising:

communicating the optical clock signal from an on-chip optical source to the back-side of the integrated circuit device by propagating the optical clock signal vertically, through the device substrate.

4. The method of claim 2, further comprising:

capturing the secondary optical reflection during distribution of the optical clock signal from a vertical to horizontal orientation on the back-side of the integrated circuit device;

capturing the secondary optical reflection during distribution of the optical clock signal in a plurality of directions on the back-side of the integrated circuit device by a uniform, unfocused guided-wave progression; and

capturing of secondary optical reflection during distribution of the optical clock signal from a horizontal to vertical orientation on the back-side of the integrated circuit device.

5. The method of claim 2, further comprising:

distributing the optical clock signal through a printed wiring board substrate connected to the integrated circuit device; and

out-coupling of the optical clock signal from the printed wiring board substrate.

6. The method of claim 2, further comprising:

coupling of the optical clock signal from a printed wiring board substrate connected to the integrated circuit device to a package layer in the integrated circuit device;

distributing the optical clock signal through the package layer; and

out-coupling of the optical clock signal from the package layer to the back-side of the integrated circuit device.

7. The method of claim 2, further comprising:

generating the optical clock signal on the integrated circuit device.

8. The method of claim 2, further comprising:

communicating the optical clock signal from an off-chip optical source to the back-side of the integrated circuit device by propagating the optical clock signal vertically, through the device substrate.

9. The method of claim 8, further comprising:

routing the optical clock signal to at least one point of fanout before directly communicating the optical clock signal to the back-side of the integrated circuit device.

10. The method of claim 8, further comprising:

routing the optical clock signal to at least one point of fanout; and

communicating with a fixed-fanout on-chip distribution, with each point of fanout communicating the optical clock signal to the back-side of the integrated circuit.

11. A structure for unfocused guided-wave optical clock distribution, comprising:

an integrated circuit device;

a first cladding layer disposed on the back-side of the integrated circuit device; and

a core layer disposed on the first cladding layer, wherein the core layer includes at least one vertical-to-horizontal input diffraction grating, at least one horizontal-to-horizontal diffraction grating, and at least one horizontal-to-vertical output diffraction grating.

12. The structure of claim 11, wherein the first cladding layer is a write-wavelength vertical reflection absorption layer.

13. The structure of claim 11, further comprising:

a second cladding layer adjacent to the core layer.

14. The structure of claim 11, further comprising:

a horizontal reflection absorption layer adjacent to the core layer.

15. The structure of claim 11, further comprising:

at least one chip-level detector on the integrated circuit device.

16. The structure of claim 11, further comprising:

at least one chip-level optical via; and

a printed wiring board substrate connected to the integrated circuit device.

17. The structure of claim 16, wherein the at least one optical via is a dielectric filled through-wafer via.

18. The structure of claim 11, further comprising:

at least one chip-level optical source.

19. A structure for unfocused guided-wave optical clock distribution, comprising:

an integrated circuit device;

a first cladding layer disposed on the back-side of the integrated circuit device, wherein the first cladding layer includes at least one vertical-to-horizontal input diffraction grating, at least one horizontal-to-horizontal diffraction grating, and at least one horizontal-to-vertical output diffraction grating; and

a core layer disposed on the first cladding layer.

20. The structure of claim 19, wherein the at least one vertical-to-horizontal input diffraction grating is a multiplexed grating and the at least one horizontal-to-vertical output diffraction grating is a multiplexed grating.

21. The structure of claim 19, wherein the first cladding layer is comprised of a grating selected from volume gratings, surface-relief gratings, multiplexed volume gratings, double-sided surface relief gratings, and combinations thereof.

22. A structure for unfocused guided-wave optical clock distribution, comprising:

an integrated circuit device;

a first cladding layer disposed on the back-side of the integrated circuit device;

a core layer disposed on the first cladding layer, and

a second cladding layer disposed on the core layer, wherein the second cladding layer includes at least one vertical-to-horizontal input diffraction grating, at least one horizontal-to-horizontal diffraction grating, and at least one horizontal-to-vertical output diffraction grating.

23. The structure of claim 22, further comprising:

a vertical reflection absorption layer adjacent to the second cladding layer.

24. The structure of claim 23, wherein the vertical reflection absorption layer absorbs at an optical wavelength which is transparent to the device substrate.

25. A device, comprising:

a structure having a core layer disposed on the back-side of the structure, at least one vertical-to-horizontal input diffraction grating within the core layer, at least one horizontal-to-horizontal diffraction grating within the core layer, at least one horizontal-to-vertical diffraction output grating within the core layer, and at least one cladding layer engaging the core layer, wherein an optical clock signal is propagated vertically through the structure substrate to the core layer, into the at least one vertical-to-horizontal input diffraction grating and is then distributed laterally through the at least one horizontal-to-horizontal diffraction grating to the at least one horizontal-to-vertical output diffraction grating, which distributes the optical clock signal vertically back through the structure substrate.

26. A device of claim 25, wherein the structure for optical clock distribution is included in a microelectronic device.

27. A device of claim 25, wherein the structure for optical clock distribution is included in an integrated optical device

28. A method for fabricating a device having unfocused guided-wave optical clock distribution comprising:

providing a substrate having a first cladding layer disposed thereon;

disposing a core layer on the first cladding layer;

forming vertical-to-horizontal input diffraction gratings within the core layer;

forming horizontal-to-horizontal diffraction gratings within the core layer; and

forming horizontal-to-vertical output diffraction gratings within the core layer.

29. The method of claim 28, further comprising:

etching away a portion of the core layer at the edges of the substrate and replacing it with a horizontal reflection absorption layer.

30. The method of claim 28, wherein the device includes at least one detector.

31. The method of claim 28, wherein the device includes an optical via and further comprising a packaging layer and a printed wiring board substrate.

32. The method of claim 28, wherein the device includes an optical source.

33. The method of claim 28, further comprising:

disposing a second cladding layer on the core layer.

34. The method of claim 33, further comprising:

disposing a vertical reflection absorption layer on the second cladding layer.

35. A method for fabricating a device having unfocused guided-wave optical clock distribution comprising:

providing a substrate having a first cladding layer disposed thereon;

forming vertical-to-horizontal input diffraction gratings within the first cladding layer;

forming horizontal-to-horizontal diffraction gratings within the first cladding layer;

forming horizontal-to-vertical output diffraction gratings within the first cladding layer; and

disposing a core layer on the first cladding layer.

36. A method for fabricating a device having unfocused guided-wave optical clock distribution comprising:

providing a substrate having a first cladding layer disposed thereon;

disposing a core layer on the first cladding layer;

disposing a second cladding layer on the first cladding layer;

forming vertical-to-horizontal input diffraction gratings within the second cladding layer;

forming horizontal-to-horizontal diffraction gratings within the second cladding layer; and

forming horizontal-to-vertical output diffraction gratings within the second cladding layer.

37. A system for fabricating a device having back-side-of-die, through-wafer optical clock distribution comprising:

means for providing a substrate having a first cladding layer disposed thereon;

means for disposing an core layer on the first cladding layer;

means for forming vertical-to-horizontal input diffraction gratings within the core layer;

means for forming horizontal-to-horizontal diffraction gratings within the core layer; and

means for forming horizontal-to-vertical output diffraction gratings within the core layer.